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REMARKS ON SOME CHESTER PENTREMITES

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A fossil collecting trip to Crane, Indiana, in October, 1944, yielded a rich collection of bryozoans, brachiopods, blastoids, corals, crinoids, gastropods, echinoid spines, and trilobites (here approximately listed in order of abundance), a few *Spirorbis*, and a single pelecypod from the Glen Dean limestone (uppermost Middle Chester, Mississippian). Only the blastoids, all of which are referable to the genus *Pentremites* Say, are dealt with in this article. It is intended to publish some observations on the genus *Archimedes* and an annotated faunal list in the near future.

In addition to the specimens collected by the writer, some previously present in the collections of the American Museum of Natural History have been included in the present study, as well as a collection sent to this museum for study and identification by Lieut. William N. Dale, U.S.N., of Crane, Indiana. Our thanks are due to Lieutenant Dale for permission to keep some specimens of particular scientific interest for the museum collections and for calling my attention to the hitherto unexploited fossil localities, all of which are within the area of the Naval Ammunition Depot, Crane, Indiana, and for most helpful support of my work there.

The following 10 forms of *Pentremites*, totaling about 280 specimens, can be recognized:

Pentremites spicatus Ulrich, *sensu lato*

Altogether about 70 specimens, plus numerous fragments

Figures 1–13

Long before the creation of this species by Ulrich (1917, p. 263, pl. 7, figs. 33–35) it was, according to S. Weller (1920, pp. 371, 372; see also Wood, 1909, p. 16, pl. 3, figs. 14–16), named *P. cherokeus* by Troost (1850, p. 60). This name, however, was a *nomen nudum*, used some years later by Hall (1858, p. 691, pl. 25, fig. 12) for a somewhat different form. Later, the blastoids belonging to *P. spicatus* were usually, though wrongly, referred to *P. sulcatus* Roemer (1851, p. 355, pl. 6, fig. 10, pl. 4, figs. 5, 6, pl. 5, fig. 7) which, however, lacks, even at a considerable size, the sharp spikes characteristic of the present species and has a broader base.

When establishing this species, which may be considered one of the best index fossils of the Glen Dean horizon and which certainly is the most spectacular, Ulrich (*loc. cit.*) stated that "the available material of *P. spicatus*. . .is divisible into three or four varieties differing from each other in the relative height of the pelvis, in the shape of the calyx, and in minor details of the structure." However, Ulrich illustrated just one individual, which thus became the holotype of the typical *P. spicatus*, without depicting, defining, or naming any of the other forms distinguishable within this species; at least two of them, however, seem so clearly distinct from the typical one as to deserve varietal names.

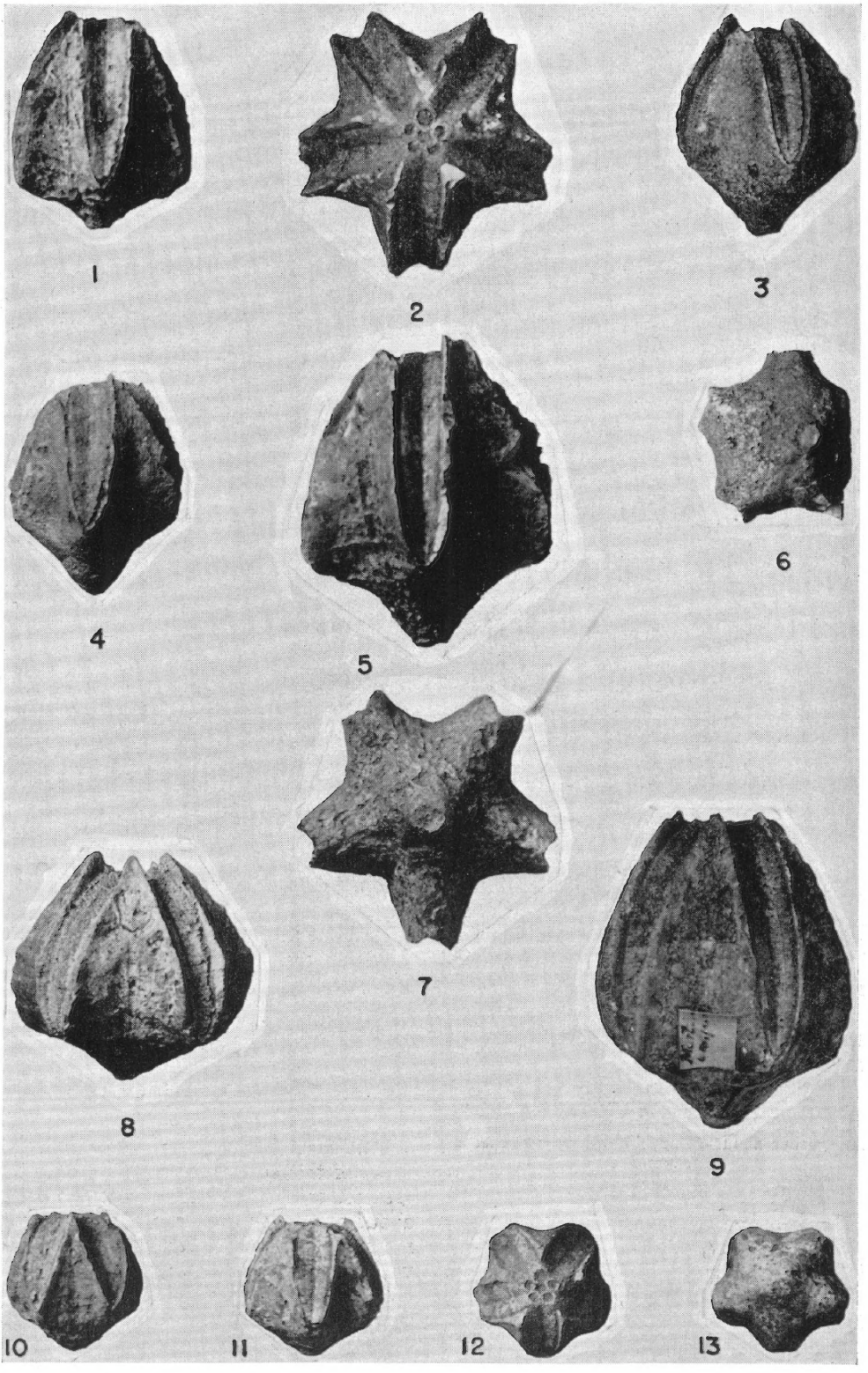
Within the present material the following forms of *P. spicatus, sensu lato*, are recognized:

(A) **forma typica**

About 45 specimens

Figure 8

This form is characterized, within the scope of this species, by the fact that the greatest transverse diameter of the calyx about equals, or even exceeds, its height, measured from the columnar facet to the very tips of the deltoids; accordingly, the calyx tapers rather quickly toward the summit. In addition to Ulrich's holotype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the two specimens simultaneously illustrated by Butts (1917, p. 100, pl. 24, figs. 3, 4), all the individuals of the fine ontogenetic series shown by Hambach (1903, pl. 6) under the name *P. sulcatus* (with the exception of the one represented in fig. 8 of that plate), and the calyx figured under the same name by Rowley (1903, pl. 36, fig. 4) appear to be referable to this typical form, as does Troost's type of his "*P. cherokeus*" illustrated only in 1909 by Wood (pl. 3, figs. 14–16). A specimen from Crane, with three sharp spikes out of five well preserved, is believed to be particularly characteristic of this form and is, therefore, shown in figure 8.

(B) Var. **porrecta,** new variety

22 specimens

Figures 1, 2, 5, 7, 9, 10

The height of the calyx, measured as above, decidedly exceeds its greatest transverse diameter; accordingly, the calyx tapers more gently in this form than in the typical one. Among several fine specimens the largest one, matching Ulrich's holotype of this species in width and even exceeding it in height, is designated the holotype of this variety (figs. 2, 5, 7). Two paratypes from the same locality, one representing an earlier ontogenetic stage, the other remarkable for being particularly slender, are shown in figures 10 and 1, respectively.

Of previously figured individuals those shown in Hambach's (1903, pl. 6) figure 8 and S. Weller's (1920, pl. 10) figure 8 (reproduced by J. M. Weller, 1931, pl. 44, fig. 3) are believed to belong to this variety.

Furthermore, a spectacular specimen from the Chester group (probably Glen Dean formation also) of "6 mi. from Shoals, Martin County,[1] Indiana," in the collections of the American Museum of Natural History, measuring 45 mm. in height and 36 mm. in width, originally determined as *P. basilaris* Hambach,[2] is referred to this variety instead, although it slightly differs from its holotype by having less-developed deltoidal spikes and less prominent ridges bordering the ambulacra. This specimen is shown in figure 9.

(C) Var. **altipelvis,** new variety

4 specimens

Figures 3, 4, 6, 11–13

As pointed out by Ulrich (*loc. cit.*), there is considerable variation as to the relative height of the pelvis in *P. spicatus;* this holds true for the typical form as well as for the variety *porrecta.* However, a third, though less abundant, form can readily be distinguished from the two preceding ones by the height of its pelvis which attains a third of the total height of the

[1] The localities near Crane where I collected are in the same county.

[2] This species has, according to Greger (1934, p. 147), never been recorded again since its creation by Hambach (1886, p. 159, pl. B, fig. 9). According to its author it differs from *P. "sulcatus"* (= *spicatus*) by having a more horizontal base and, as may be added, broader, less ogival ambulacra, but Rowley (1903, pp. 163, 194) declares it to be a synonym of *Pentremites "sulcatus."*

Figs. 1–13. *Pentremites spicatus* Ulrich, *sensu lato.*

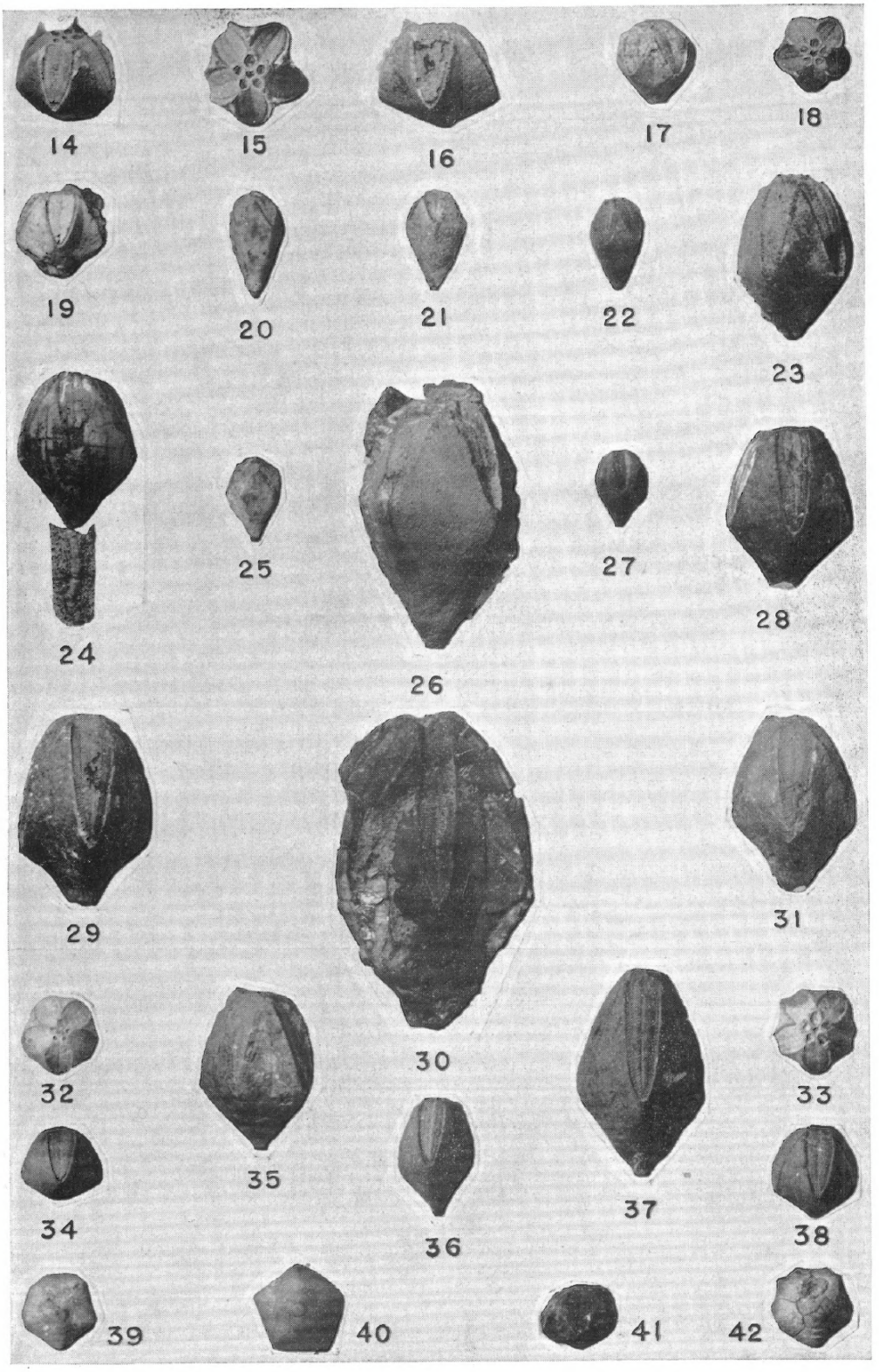
Fig. 8. *Forma typica;* hypotype, A.M.N.H. No. 26057/5:1; quarry "IIc."

Figs. 1, 2, 5, 7, 9, 10. Var. *porrecta,* new variety. 2, 5, 7, Holotype, A.M.N.H. No. 26058/2: 1; quarry "II"; 2, apical view, 5, side view, 7, basal view. 1, Paratype A.M.N.H. No. 26058/2 : 2; qarrry "II"; side view. 10, Paratype A.M.N.H. No. 26058/2:3; quarry "II"; side view. 9, A somewhat deviating paratype, A.M.N.H. No. 7846/1; side view.

Figs. 3, 4, 6, 11–13. Var. *altipelvis,* new variety. 3,6, Holotype, A.M.N.H. No. 26059; 3, side view, 6, basal view. 4, Paratype A.M.N.H. No. 26059/1:1; quarry "II"; side view. 11–13, Paratype A.M.N.H. No. 26059/2 : 1; quarry "IIa"; 11, side view, 12, apical view, 13, basal view.

The specimen shown in figure 9 is from the Chester group (probably Glen Dean), 6 miles from Shoals, Martin County, Indiana. All the others are from the Glen Dean limestone of the vicinity of Crane, Martin County, Indiana. For specimens collected by the writer himself more precise locality data are given by numbers assigned by him to various quarries and other localities in that vicinity.

All figures are natural size.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calyx or even slightly more. The specimen A.M.N.H. No. 26059, collected by Lieutenant Dale, is designated the holotype of this variety (figs. 3, 6). A paratype, representing an earlier ontogenetic stage, is illustrated in figures 11–13; another, of about the same size as the holotype but with an even higher pelvis, in figure 4.

No specimens referable to the variety *altipelvis* could be found in the previous literature.

Pentremites cherokeeus Hall

5 specimens

Figures 14–16

As S. Weller (1920, pp. 371–372) justly emphasizes, this species has to be interpreted solely on the strength of Hall's (1858, p. 691, pl. 25, fig. 11) description and figures. If so, it is found to be distinguished by developing at a comparatively early stage deltoidal spikes and particularly by the tendency of the latter to bend outward, thus producing a slight concavity in the deltoidal edges immediately below them. Except for the last feature and for its smaller size, this species closely resembles *P. spicatus;* it has the width of the calyx in common with the typical form of Ulrich's species, and the relative height of the pelvis with its variety *altipelvis.* From small individuals of the latter variety those of *P. cherokeeus* can be distinguished only if the spikes are well enough preserved to disclose their centrifugal trend. Thus

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Figs. 14–16. *P. cherokeeus* Hall. 14, 15, Hypotype, A.M.N.H. No. 26060/1:1; quarry "IIc"; 14, side view (slightly inclined, to show spikes in the rear), 15, apical view. 16, A.M.N.H. No. 26060/1:2; quarry "IIc"; side view; note serrate left margin.

Figs. 17–19. *P. elegans* Lyon. 17, Smallest specimen present, A.M.N.H. No. 26061/1:1; quarry "IIc"; side view, × 3/2. 18, A.M.N.H. No. 26061:1; quarry "IIa"; apical view. 19, Hypotype, A.M.N.H. No. 26061/1:2; quarry "IIc"; side view.

Figs. 20–22. *P. okawensis* S. Weller. 20, A specimen with particularly high pelvis, A.M.N.H. No. 26063/2:1; locality "III"; side view. 21, Hypotype, A.M.N.H. No. 26063/1:1; quarry "IIa"; side view. 22, A small specimen, A.M.N.H. No. 26063:1; quarry "II"; side view, × 3/2.

Figs. 23–26, 28. *P. pyramidatus* Ulrich. 23, Hypotype, A.M.N.H. No. 26062/2:2; quarry "IIc"; side view. 24, A medium-sized specimen with stalk, A.M.N.H. No. 26062/3:2; locality "III"; side view. 25, A small specimen with comparatively short ambulacra, A.M.N.H. No. 26062/3:1; locality "III"; side view. 26, Largest specimen present, A.M.N.H. No. 26062/2:1; quarry "IIc"; side view. 28, Another medium-sized specimen, A.M.N.H. No. 26062/1:1; quarry "II"; side view.

Figs. 29–31, 35. *P. lyoni* Ulrich, *forma typica.* 29, Hypotype (closely resembling the holotype). A.M.N.H. No. 26064; side view. 30, An unusually large, crushed individual, A.M.N.H. No. 26064/1:2; quarry "I"; side view. 31, A specimen closely resembling Ulrich's (1917, pl. 7) figure 29, A.M.N.H. No. 26064/3:1; quarry "II"; side view. 35, A specimen closely resembling Ulrich's (1917, pl. 7) figure 28, A.M.N.H. No. 26064/1:1; quarry "I"; side view.

Figs. 27, 36, 37. *P. lyoni* Ulrich, var. *gracilens* Ulrich. 27, A small specimen, closely resembling Ulrich's (1917, pl. 7) figure 31, A.M.N.H. No. 26065/3; quarry "IIc"; side view. 36, A specimen closely resembling Ulrich's (1917, pl. 7) figure 32, A.M.N.H. No. 26065:1; side view. 37, Hypotype (nearly as slender as, and markedly larger than, the holotype), A.M.N.H. No. 26065:2; side view.

Figs. 32, 34, 39, 40. *P. brevis* Ulrich. 32, 34, 39, Hypotype, A.M.N.H. No. 26068:1; 32, apical view, 34, side view, 39, basal view. 40, Basal view of a small calyx, A.M.N.H. No. 26068:2, × 3/2.

Fig. 41. *P.* cf. *brevis* Ulrich. A.M.N.H. No. 26069; quarry "I"; side view.

Figs. 33, 38, 42. *P. hambachi* Butts ? A.M.N.H. No. 26070; 33, apical view, 38, side view, 42 basal view.

All specimens are from the Glen Dean limestone of the vicinity of Crane, Martin County, Indiana. For specimens collected by the writer himself more precise locality data are given by numbers assigned by him to various quarries and other localities in that vicinity.

Unless otherwise indicated, the figures are natural size.

the question may well be raised whether *P. cherokeeus* should not better be relegated to the rank of another variety of *P. spicatus*.[1]

A comparatively well-preserved specimen of *P. cherokeeus* from Crane is shown in figures 14 and 15, a less well-preserved one in figure 16, the latter for exhibiting the same "crimped" sharp edge as the individual figured by Rowley (1903, p. 116, pl. 36, fig. 6). It might be added that the latter feature occurs, as previously stated by S. Weller (1920, p. 368, "serrate margin [of] the plates"),[2] sometimes in *P. spicatus* as well, e.g., in the holotypes of both the typical form and the new variety *porrecta*. This fact further supports the above assumed close relationship of *P. spicatus* and *P. cherokeeus*.

Pentremites elegans Lyon

13 specimens, 5 only doubtfully referred to this species

Figures 17–19

This species, judged as it has to be by Lyon's (1860, p. 632, pl. 20, fig. 4) original description and figures, appears to be distinguished by having the greatest diameter of the calyx somewhat below the middle of its height, by the neatly concave interambulacral areas, each consisting of two even planes which meet at the clearly marked median suture at a pronounced though obtuse angle, and by the shortness of the deltoids which do not reach the face of the summit even in the holotype, much less so in smaller individuals, and which cling to the curvature of the calyx.[3]

Especially if viewed apically, some of our specimens referred to this species are rather similar to *P. canalis* Ulrich (1917, p. 262, pl. 7, figs. 23–26; Butts, 1917, p. 100, pl. 24, fig. 7) which differs, however, from *P. elegans* by having flat ambulacra, hardly concave interambulacral areas, and "the distinct narrow canal-like furrow at the bottom of the ambulacral area" (Butts, *loc. cit.*). Another Glen Dean species resembling *P. elegans* in certain characters is *P. hambachi* Butts (1926, p. 198, pl. 65, fig. 2), but it is readily distinguished by its more globose shape, its shorter pelvis, and its considerably longer ambulacra which descend markedly below the maximum width of the calyx.

The smallest specimen present and a medium-sized one are shown in side views in figures 17 and 19, respectively; in addition, the apical view of a small calyx is given in figure 18.

Pentremites pyramidatus Ulrich

About 25 specimens, one with stalk preserved

Figures 23–26, 28

This species of Ulrich's (1905, p. 64, pl. 7, figs. 12–14; see also Butts, 1917, p. 99, pl. 24, fig. 1) is characterized by the gentle convexity of the outlines of the upper part of the calyx on the one hand and by the clearly pyramidal shape of its lower part, which is surrounded by five plain faces, on the other. The upper parts of the radials and the deltoids, though slightly convex in the vertical sense, are flat, not concave, transversely. The ambulacral areas are not, or only very slightly, depressed, except for the pronounced median furrow which is rather deep in some specimens.

Only two of these distinctive characters, however, serve to separate this species from the contemporaneous, closely related *P. lyoni* Ulrich (see below). S. Weller (1920, p. 326) believes that the latter "differs from *P. pyramidatus* chiefly by reason of its gently concave interambulacra." This is, however, only one of two differences prevailing between these two species. There is still another, which proves, in my opinion, no less helpful. The lower ends of the ambulacra are marked in both species by sharp, vertically elongated projections, which may be even more pronounced in some individuals of *P. lyoni*

[1] This would, at least approximately, restore the original taxonomic situation, since Hall believed his form to be conspecific with Troost's which much later turned out to belong to *P. spicatus*. On the other hand, the inclusion by Hall (1858, p. 691) of *P. sulcatus* Roemer in the synonymy of *P. cherokeeus* can, for the reasons stated above, certainly not be maintained.

[2] An extreme development of this feature is found in *P. serratus* Hambach (1903, p. 56, pl. 4, fig. 9; Butts, 1917, p. 116, pl. 28, figs. 10, 11) which Rowley (1903, p. 163), however, considers to be merely "an extravagant form of *P. sulcatus*."

[3] Whitfield's (1891, p. 577, pl. 13, fig. 4 = 1893, p. 466, pl. 9, fig. 4) Ohio specimen, refigured by Morse (1914, p. 360, fig. 2), might represent a slender variety of *P. elegans*. Troost's *P. tennesseeae* (*nomen nudum;* see Wood, 1909, p. 14, pl. 2, figs. 10–12) is certainly not conspecific with Lyon's species; it seems to be much closer to *P. pyramidatus* Ulrich (see below).

than they are generally in *P. pyramidatus*. However, while these prominences tend to vanish farther down the pelvis in the former species, they continue as distinct though sometimes blunt edges toward the columnar facet in the latter. Curiously, this difference can be tested even better by touch than by sight; if the basis is spun between two fingers, the edges are well felt in *P. pyramidatus*, but not in *P. lyoni*. It must be admitted that the specimens figured by S. Weller (1920, pl. 4, figs. 21–29)[1] under the name of *P. pyramidatus* do not exhibit the distinct edges here thought to be characteristic of this species, but it must be kept in mind that they are from the Paint Creek formation, whereas the true *P. pyramidatus* Ulrich is a "Birdsville," more specifically a Glen Dean, form (see Ulrich, 1905, p. 64; Ulrich, 1917, pp. 185, 220, 226; Butts, 1917, pp. 98, 99; Butts, 1926, p. 198). Thus the conspecificity of Weller's Paint Creek specimens cannot be considered to be beyond any doubt.

A specimen of about the same size as that illustrated by Butts (1917, pl. 24, fig. 1), but somewhat higher and more slender and with shorter ambulacra, is shown in figure 26. Considering its close similarity with that specimen of Butts (whose identification may be assumed to have met with Ulrich's approval), it is left with this species despite the fact that its pelvis is higher than in Ulrich's (1905) types. Two small specimens, one of which is shown in figure 25, also exhibit comparatively short ambulacra. Three medium-sized individuals, believed to be typical of this species, are illustrated in figures 23, 24, and 28.

Pentremites okawensis S. Weller

12 specimens

Figures 20–22

This species (Weller, 1920, p. 357, pl. 10, figs. 5[2]–7; Butts, 1926, p. 198, pl. 65, fig. 4) is somewhat reminiscent of, and probably closely related to, *P. pyramidatus*, but is clearly distinguishable from it by the extraordinary height of the dorsal region, which occupies from about three-fifths to about two-thirds of the total height of the calyx; the former ratio is found in S. Weller's types, the latter in Butts' specimen from Alabama as well as in most of those in the present material. The ambulacra do not extend beyond the greatest width of the body. They are, therefore, short and appear shorter and broader, the higher the pelvis. This makes our specimens look somewhat different from S. Weller's types, though very much like Butts' form. An individual with particularly high pelvis is shown in figure 20; another, which is only slightly stouter, in figure 21, and a small one, whose dorsal part attains only about three-fifths of the total height, in figure 22.

Pentremites lyoni Ulrich, *sensu lato*

Altogether about 95 specimens

Figures 27, 29–31, 35–37

This species of Ulrich's (1917, pp. 262, 263, pl. 7, figs. 27–32) is represented in the material examined by the largest number of individuals. As indicated by S. Weller (1920, p. 326), this species is pretty close to *P. pyramidatus* Ulrich; for ways and means of distinguishing them all the same reference is made to the above discussion of the latter species (p. 6).

Both forms distinguished by Ulrich (*loc. cit.*) within this species are present:

(A) forma typica

About 50 specimens, one with stalk preserved

Figures 29–31, 35

The variations studied by Ulrich in this, the stouter form of *P. lyoni*, are recognizable in the material from Crane as well. Some individuals, e.g., the hypotype shown in figure 29, most closely resemble the holotype (Ulrich, 1917, pl. 7, fig. 27); others, e.g., the specimen illustrated in figure 35, Ulrich's (*op. cit.*) figure 28, still others, of which figure 31 shows a good example, his figure 29. In addition, there are five specimens present which, measuring up to 45 mm. in height, by far exceed in size all those figured by Ulrich. All are, however, badly crushed, and it cannot be determined with any degree of certainty how far the

[1] Figures 23 and 24 are reproduced by J. M. Weller (1931, pl. 41, figs. 12, b, a).

[2] Reproduced by J. M. Weller, 1931, pl. 42, fig. 8.

deep concavity of some of their interambulacral areas is due merely to crushing. Be that as it may, they agree in all other characters, so well with *P. lyoni* that they, too, are referred to this species. The largest of these calyces is shown in figure 30.

(B) Var. **gracilens** Ulrich

About 45 specimens, one with stalk preserved

Figures 27, 36, 37

This variety, deviating from the typical form by being more slender, but displaying, like the former, considerable variation within itself, is also well represented at Crane. Most of the variants distinguished by Ulrich in his material can also be recognized here. The small individual illustrated in figure 27 is reminiscent of Ulrich's (1917, pl. 7) figure 31; the fine specimen shown in figure 36, of his figure 32. There is, however, none so slender as Ulrich's holotype (*op. cit.*, fig. 30); the individual illustrated in figure 37 (hypotype) comes closest to it in slenderness. It is markedly larger than the holotype, but it is still exceeded in size by a much less well-preserved specimen from quarry "II" which, when complete, must have measured at least 35 mm. in height.

Pentremites brevis Ulrich

8 specimens

Figures 32, 34, 39–41

This species, established but neither described nor figured by Ulrich in 1917 (p. 226), was first illustrated by Butts (1917, p. 100, pl. 24, fig. 6), but more thoroughly studied and discussed only by S. Weller (1920, p. 369, pl. 4, figs. 43–46). This author also described the differences between this species and his closely related, somewhat older *P. platybasis* (1920, p. 355, pl. 4, figs. 37–42).

A small but perfectly preserved calyx from Crane, closely resembling those figured by Weller (*loc. cit.*) as well as the one illustrated by Butts (1926, p. 198, pl. 65, fig. 3) from the Bangor limestone of Alabama, is shown in figures 32, 34, and 39 in apical, lateral, and basal views. The stem facet is seen even more clearly in the basal view (fig. 40) of an even smaller calyx. Two individuals from Crane, one of which (base incomplete) is shown in figure 41, seem to be unusually depressed and markedly wider than all previously figured individuals of this species; they are too poorly preserved to warrant separation of a variety, and are merely labeled *P.* cf. *brevis* Ulrich.

ADDENDUM

Pentremites hambachi Butts?

1 specimen

Figures 33, 38, 42

After completion of the above report three more excellently preserved specimens of *Pentremites* were received from Lieutenant Dale. One of them cannot well be placed with any of the forms from Crane hitherto listed in the present paper. It approaches most closely our specimens referred to *P. elegans* (p. 6, figs. 17–19), but its interambulacral areas are not so pronouncedly concave, and its ambulacra are somewhat narrower and, except for the median furrow, not deepened. Furthermore, the pelvis is much shorter in this specimen than in either *P. elegans* or *P. canalis*, and its ventral region is more curved than in the latter species. All these differences make for a close similarity of this calyx with the holotype and only figured specimen of *P. hambachi* Butts (1926, p. 198, pl. 65, fig. 2). However, it differs from the latter by the fact that the ambulacra, though fairly long, do not reach beyond the maximum width of the calyx, as they do in the holotype. Although this difference may be due to ontogenetic reasons only, the present specimen is only doubtfully referred to Butts' species. It is remarkable for neatly showing, in basal view (fig. 42), all the boundary lines of the three basal plates.

This individual increases the number of *Pentremites* forms in the material from Crane from 10 to 11.

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